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ABSTRACT

The National Assessment of Educational Progress (NAEP) continuously monitors the knowledge, skills, and performance of the nation's children and youth in a variety of academic subjects. Data from the NAEP 1996 Long-Term Trend Science Assessment show mixed results since the first assessment. Scores for all three age groups fell and then rose. Both 9- and 13-year-olds showed an overall increase, but 17-year-olds showed an overall decline. Scores for white students were higher than for blacks and hispanics for all three age groups, although scores for 9- and 13-year-old black students did improve, both absolutely and in comparison with white students. Thirteen-year-old and 17-year-old male students had higher scores than female students. (ASK)

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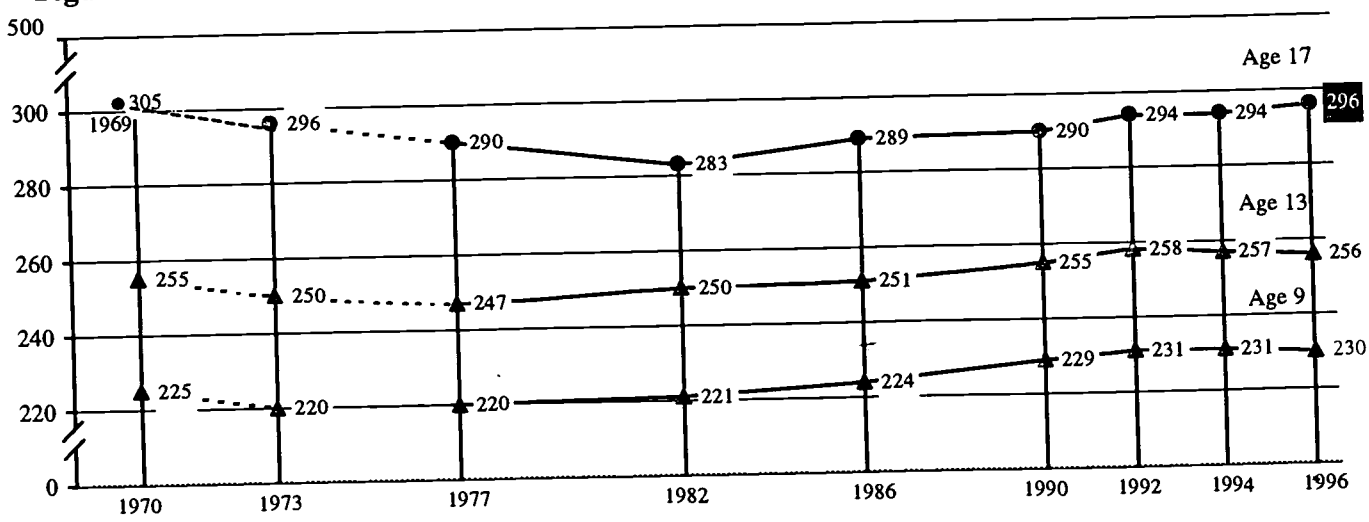
Long-Term Trends in Student Science Performance

Summary: Data from the NAEP 1996 Long-Term Trend Science Assessment show mixed results since the first assessment. Scores for all three age groups fell and then rose. Both 9- and 13-year-olds showed an overall increase, but 17-year-olds showed an overall decline. Scores for white students were higher than for blacks and Hispanics for all three age groups, although scores for 9- and 13-year-old black students did improve, both absolutely and in comparison with white students. Thirteen-year-old and 17-year-old male students had higher scores than female students.

The National Assessment of Educational Progress (NAEP) continuously monitors the knowledge, skills, and performance of the nation's children and youth in a variety of academic subjects. The data collected are available in major reports. The *NAEPfacts* series takes selected data from these reports and uses them to highlight specific issues of particular interest to teachers, researchers, policymakers, and other individuals with an interest in education.

Figure 1.— NAEP Science Average Scale Scores for the Nation



Triangular data markers indicate a positive linear trend (scores show an overall increase).

Round data markers indicate a negative linear trend (scores show an overall decrease).

Red data markers indicate a positive quadratic trend (scores fell or remained flat and then rose).

Red numbers indicate 1996 scores were significantly higher than 1970 scores, at a 5 percent combined significance level per set of comparisons.

White numbers on a red background indicate 1996 scores were significantly lower than 1969 scores, at a 5 percent combined significance level per set of comparisons.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

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The assessments used by NAEP to evaluate long-term trends in student performance began in the early 1970s. Three long-term assessment series—in science, mathematics, and reading—began at this time. Students were assessed at ages 9, 13, and 17. In 1984 a fourth subject, writing, was added.

Over the past 28 years, NAEP has administered nine long-term trend assessments to monitor progress in the science performance of 9-, 13-, and 17-year-old students. NAEP has used the same administration procedures and assessment content in each of these assessments, in order to measure trends in science achievement over time.

Table 1.—Average Scale Scores in Science by Race/Ethnicity and Gender

	Age 9			Age 13			Age 17		
	1970†	1996	Trend	1970†	1996	Trend	1969†	1996	Trend
Nation	**225***	**230**	**LQ**	**255**	**256**	**LQ**	**305***	**296**	**lQ**
White	236	239	LQ	263	266	LQ	312*	307	Q
Black	179*	202	L	215*	226	L	258	260	LQ
Hispanic	192*	207	L	213*	232	L	262	269	L
Male	228	231	LQ	257	260	LQ	314*	300	lQ
Female	223*	228	LQ	253	252	LQ	297*	292	Q

†For Hispanic students, the data cover assessments from 1977 to 1996.

*Statistically significant difference from 1996, at a 5 percent combined significance level per set of comparisons.

L=Positive Linear Trend l=Negative Linear Trend

Q=Positive Quadratic Trend q=Negative Quadratic Trend

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment. Consult this publication for graphs and complete scale score data for all subgroups on each assessment.

Analyzing Long-Term Trend Data

Long-term trend data can be analyzed in a number of ways. Student scores for given years can be compared for statistically significant differences. In this report, scores for student groups or subgroups from the first assessment are compared with the results from the most recent assessment. Scores are described as "higher" or "lower" only if the difference is statistically significant— that is, unlikely to be the result of the chance factors associated with the inevitable sampling and measurement errors inherent in any large-scale sample survey effort like NAEP.

It is also possible to analyze a series of scores for overall trends, rather than year-to-year variations. Specifically, a series of scores can be analyzed for "linear" and "quadratic" trends. Linear trends can be represented as straight lines. A positive linear trend indicates that overall the average scores for a given student group form a rising line, while a negative linear trend indicates a declining one. A series of scores can show a linear trend despite wide variation among individual scores, as long as the overall pattern is either up or down.[1]

Quadratic trends can be represented as simple curves, and can be represented mathematically by quadratic equations.[2] A positive quadratic trend indicates that scores form a simple curve with one or both ends higher than its center—scores sagged and then either leveled off or rose, or were flat and then rose. A negative quadratic trend indicates a simple curve whose center is higher than one or both ends—scores rose and then either leveled off or declined, or were flat and then declined.

It is possible for scores to display both a linear and a quadratic trend. For example, if scores rose sharply and then flattened out, this would constitute a negative quadratic trend. However, if the pattern of the scores still showed an increase for the entire time period, the scores would also display a positive linear trend.

Overall Performance

Scores for all three age groups showed a positive quadratic trend over the years 1970–1996 (see figure 1). That is, scores fell and then rose. (For 17-year-olds only, the first assessment was given in 1969). For both 9- and 13-year-olds, scores rose enough to achieve a positive linear trend. Scores for 17-year-old students did not, showing a negative linear trend. The average score for 9-year-olds in 1996 was higher than scores in 1970. The 1996 average score for 17-year-olds was lower than the 1969 average. The average score for 13-year-olds in 1996 was neither higher nor lower than in 1969.

Race/Ethnicity and Gender

With one exception, scores for white students mirrored overall performance (see table 1). All three age groups showed a positive quadratic trend, as scores first fell and then rose. Both 9- and 13-year-old white students– showed a positive linear trend, as did 9- and 13-year-olds overall. Unlike 17-year-olds overall, 17-year-old white students did not show a negative linear trend. But like them their 1996 average was lower than their 1969 average.

Scores for black and Hispanic students generally showed improved performance. Scores for both black and Hispanic students showed positive linear trends at all three age levels, as scores trended upwards over

time. (Separate data for Hispanic students only go back as far as 1977.) Scores for black 17-year-olds showed a positive quadratic trend, as scores first fell and then rose. Black students at age 9 and 13 had higher scores in 1996 than in 1970. Hispanic students in the same age groups had higher scores in 1996 than in 1977.

Results for male students mirrored overall results, with one exception: 9-year-old males did not have significantly higher scores in 1996 than in 1970. Results for female students were also very similar to overall results. All three age groups showed a positive quadratic trend; age 9- and 13-year-olds showed a positive linear trend; 17-year-olds did not show a negative linear trend, but their 1996 average score was below their 1969 score. Nine-year-old females, like 9-year-olds overall, had a higher average score in 1996 than in 1970.

Performance Differences

As in the past, the 1996 Long-Term Trend Science Assessment found some differences in the performance of different racial/ethnic subgroups and between male and female students. In general, scores for white students have tended to be higher than scores for black and Hispanic students, and scores for male students have tended to be higher than scores for females. Table 2 displays the differences in average scale scores for the1969–70 and 1996 assessments, as well as the trends in performance differences over all the assessments between 1969–70 and 1996. (For Hispanics only, comparisons cover the years 1977–1996.)

The difference between average scale scores for blacks and whites showed a negative linear trend for all three age groups; that is, the size of the difference declined over time. The difference in scores for both 9- and 13-year-olds also showed a positive quadratic trend—the difference remained unchanged for the first few assessments, and then began to decline. In addition, the difference in scores for these two age groups was lower in 1996 than in 1970.

The difference in scores for black and white 17-year-olds showed a decline because scores for black students were trending upwards while scores for 17-year-old white students were lower in 1996 than they had been in 1969. Scores for both black and white 9- and 13-year-olds were trending upwards over time, but black students' scores showed more of an increase.

Differences in scores for white and Hispanic students showed a change over the period 1977–1996 for only one age group. The difference in scores for 13-year-olds showed a positive quadratic trend as the difference first fell and then rose. Generally, increases in Hispanics' scores were offset by increases in scores of white students.

Table 2.—Trends in Differences in Average Science Scale Scores by Race/Ethnicity and Gender

	1969–70	1996	Trends
White vs. Black Students (white minus black)			
Age 17	54	47	l
Age 13	49*	40	lQ
Age 9	57*	38	lQ
White vs. Hispanic Students† (white minus Hispanic)			
Age 17	35	38	
Age 13	43	34	Q
Age 9	38	33	
Male vs. Female Students (male minus female)			
Age 17	17*	8	l
Age 13	4	9	q
Age 9	5	4	

†For Hispanic students, the data cover assessments from 1977 to 1996.

*Differences in scores were significantly higher than in 1996, at a 5 percent combined significance level per set of comparisons.

L=Positive Linear Trend l=Negative Linear Trend

Q=Positive Quadratic Trend q=Negative Quadratic Trend

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment. Consult this publication for graphs and complete scale score data for all subgroups on each assessment.

Differences in scores between male and female students showed a few changes. The difference in scores between 17-year-old male and female students declined, comparing results for the years 1969 and 1996. The difference in scores showed a negative linear trend as well over the period 1969–1996. Scores for 17-year-old females fell, but male scores fell even more.

The difference in scores for 13-year-old males and females showed a negative quadratic trend: the difference increased and then leveled off. Scores for both male and female 13-year-olds first declined and then rose.

Conclusion

Average scale scores for science showed a mixed pattern by 1996. Scores for all three age groups fell after the initial assessment. By 1996, scores were trending upwards for 9- and 13-year-olds, but not for 17-year-olds. Scores for blacks and Hispanics showed positive

trends for all three grade levels, but scores for these students remained below the scores of white students.

Differences in scores between whites and blacks showed a downward trend for all three age groups, reflecting increases in scores among black students. There was little change in differences in scores for whites and Hispanics. Differences in scores for males and females declined for 17-year-olds only.

Notes

[1]A series of scores may show a linear trend, either positive or negative, even though a comparison of the first and last scores does not show a statistically significant difference. The reverse is true as well.

[2]Quadratic equations, familiar from elementary algebra, involve variables with a power no greater than 2. For example, the equation $y^2=R^2- x^2$ (or $y = \sqrt{R^2 - x^2}$) is a quadratic equation, in particular, the equation used for graphing a circle. For purposes of trend analysis, this equation could be used to represent either a positive quadratic trend in which scores first fell and then rose to their original starting point, or a negative quadratic trend in which scores first rose and then fell to their original starting point.

For Further Information

NAEP 1996 Trends in Academic Progress is the complete report. Single copies are available free from the National Center for Education Statistics, U.S. Department of Education, Washington, DC 20208–5653. Copies may also be obtained over the World Wide Web at **http://nces.ed.gov/NAEP/96report/97986.shtml**.

NAEPfacts briefly summarize findings from the National Assessment of Educational Progress (NAEP). The series is a product of the National Center for Education Statistics (NCES), Pascal D. Forgione, Jr., Commissioner, and Gary W. Phillips, Associate Commissioner for Education Assessment. This issue of *NAEPfacts* was written by Alan Vanneman, of the Education Statistics Services Institute, in support of the National Center for Education Statistics. To order other NAEP publications, call Bob Clemons at 202–219–1690, or e–mail bob_clemons@ed.gov.

The NCES World Wide Web Home Page is **http://nces.ed.gov/**. The NAEP World Wide Web Home Page is **http://nces.ed.gov/naep/**.

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